Penn State University Delaware County

PSU2DE

Promoting Science for Undergraduates at Penn State Univ. Delaware County!

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INSIDE THIS ISSUE:

Special points of interest:

- Career profiles
- Helpful career hints
- Scientific accomplishments and birthdays for March
- And more!!!

"March Madness" in Science!

Astrobiology, Pi Day, and fossil teeth… oh my! All of these and more you can find out about in our March issue.

Keep in mind that we just touch the tip of the iceberg of all the possible scientific disciplines and careers you can explore in your future. As a matter of fact… why wait for the future… why not start your exploration right now?!? If you have a field that you see yourself working professionally in, don't wait until you graduate to get an introduction and some valuable experience in that field. For example, say you want to work with fossils in the future, but you're not sure if you want to work out in the field or in the lab, or maybe you want to study dinosaur bones or fossil lobsters. The best way to find out is to get some real experience working in these different environments or with these different types of samples.

Start on your campus, then look to a nearby university… is there anyone at that school doing research in one of your areas of interest? Are they looking for someone to assist them with their research? A volunteer in their laboratory? At the least you may want to ask if you can visit with the faculty member and see examples of their work so you can see and hear about what is involved.

Museums are also an excellent place to learn from professionals and gain some valuable experience. See if they have internship opportunities available, during the school year and/or for the summer. All museums are more than willing to have volunteers assist them everywhere from in their laboratories to working with the exhibits in the exhibit halls. And volunteering can only be for a few hours a week to as many hours as you have free.

This type of experience and exposure to your fields of interest is so critical to obtain before you finish your undergraduate degree. Not only will it help you confirm and/or narrow down your future career pursuits, what you do and what you learn looks great on the resume and applications for graduate school! What a way to "score some points" for your future! We encourage you to start TODAY in planning out how you will be spending your summer vacation. Looking for some initial direction? Your advisors are ready and willing to help, as well as campus career service centers.

Internships, volunteering, career planning… and you thought that "March Madness" only applies to basketball!

What can I do with my science major?

Have you heard about the growing field of astrobiology??? Dr. Lynn Rothschild of NASA's Ames Research Center was kind enough to share with us a little bit about herself, what she does, and what the field of astrobiology is all about!

What is your educational background? I have a broad training in biology with degrees from Yale University, Indiana University, and Brown University.

When did you first become interested in astrobiology? I became interested in protists when I saw an amoeba through the microscope in third grade. Ever since I have wanted to study protists (protozoa and al-

(Continued on page 2)

What can I do with my science major? (cont.)

(Continued from page 1)

gae). In college I got especially interested in evolutionary biology, and in grad school in applying molecular techniques to these studies. At NASA I realized how important the physical environment was in evolution. Thus, by the time we started using the word "Astrobiology" about four years ago, I was already an astrobiologist.

What exactly does an astrobiologist do? Astrobiology is the study of the origin, evolution, and future of life writ large. We are interested in how these processes take place in a planetary context. While this is the only planet where life has been found, and is therefore the primary subject for study by biologists, we are interested in general principles governing life in the hope that we will understand its origin on Earth, if it occurs elsewhere and, if so, what is it like, and what will happen to life in the future. To do all this requires an understanding of the origin and evolution of the universe, and certainly our solar system. We need to understand the physical and chemical processes governing Earth and elsewhere. In sum, an astrobiologist contributes to one or more of these areas.

Can you give a couple of examples of what you are researching? As I mentioned, I am interested in how the environment affects evolution. My main research at the moment is in the effect of radiation—solar on Earth, solar and cosmic in space—on evolution. Specifically, my lab is studying the damaging aspects of natural radiation and how it is repaired in microbial communities in nature, for example, in Yellowstone National Park. This involves work in molecular biology and photosynthesis. From this we can get an idea how life evolved on the early earth, how it will respond to global change, and how it might survive on Mars or in space. In collaboration with my husband, Dr. Rocco Mancinelli, we have flown microbial samples in space on board satellites. At the moment, I am finishing papers on extremophiles, the effect of the sun on evolution and the influence of the Moon on evolution.

What has been the most challenging/difficult part of your job? The most difficult part is also the best part, which is the license to cross traditional disciplines. This means that I am constantly trying to get up to speed in areas far outside of my initial training, while staying current in my core areas of interest. The other difficult part is getting reviewers of grants to understand the importance of interdisciplinary work. Those who cross disciplines are vulnerable to charges of being a dilettante, and sometimes with good reason. The flip side is that I believe that done properly, intellectual cross-fertilization is what leads to the "ahas!" of our field.

Where do you see the future of this field? With the completion of the International Space Station and the increasing miniaturization of biological analyses, we should be able to test more of our hypotheses of how life survives and evolves in a space environment. Further exploration of our solar system and beyond will help us understand Earth's history, and may reveal potential niches for life elsewhere. At the other extreme, a better understanding of the origin and evolution of life on Earth, from a better understanding of the physical environment, the chemical processes leading to the origin of life, and the evolution and diversity of life, will be the driver behind the next generation of questions. Finally, advances in molecular biology will surely have an enormous impact on our understanding of life, and will provide technological breakthroughs that can be applied to Astrobiology experiments either on Earth or in space.

What is the best way to prepare for a career in Astrobiology? Start with an intense curiosity about the natural world. Get a good academic background in at least one of the sciences. Ideally biology, molecular biology or paleontology should be among them. Take advantage of research opportunities, conferences and web sites. Learn about NASA's Astrobiology Institute. Consider an advanced degree in one of the traditional disciplines that feeds into astrobiology, with a minor in a second or enter a graduate program in Astrobiology.

For further information, see the following websites:

NASA Astrobiology Institute: http://nai1.arc.nasa.gov

NASA Ames Research Center Astrobiology: http://astrobiology.arc.nasa.gov/

Penn State Astrobiology Research Center: http://psarc.geosc.psu.edu/

The Astrobiology Web: http://www.astrobiology.com

What's HOT in science at the bookstore?

There are so many excellent books currently out in the stores—which one should you choose to read??? All are fascinating with their own accounts, but here are a few we think you'll find enjoyable.

E=mc²—A Biography of the World's Most Famous Equation, by David Bodanis (2000), Berkeley Publishing Group, 337 pp, ISBN 0-425-18164-2. First off, this is not a physics book. It is a history of where the equation came from and how it has changed the world. The story is filled with anecdotes about everything from Einstein's youth to the behind-the-scenes workings of the Roosevelt administration!

Who Gave Pinta to the Santa Maria? Tracking the Devastating Spread of Lethal Tropical Diseases into America, by Robert Desowitz (1997), Harcourt Brace, xxx pp, ISBN 0-15-600585-9. We have long believed that our sanitized Western world is safe from the microbes and parasites of the tropics. Not so—nor was it ever. Tropical diseases are as American as the heart attack; yellow fever lived happily for centuries in Philadelphia; malaria made Washington DC its home; and the Ebola virus stopped off in Baltimore. The story of how such diseases arrived on our shores is a fascinating mix of history and scientific adventure and includes the medical effects of the slave trade, how war has helped spread disease, and why ecological devastation helps disease thrive.

Great Feuds in Science: Ten of the Liveliest Disputes Ever, Hal Hellman (1998), Wiley, 240 pp, ISBN 0-471-16980-3. This book takes the reader through ten of the most outrageous and intriguing disputes from the 17th-20th centuries, exploring the science and the spirit of the times. The author reveals that scientific feuds are often fueled not only by the purest of intellectual disagreements, but also by intransigence, ambition, jealousy, politics, faith, and the irresistible human urge to be right. Sample stories in the book includes the following: Urban VII vs. Galileo, an unequal contest; Newton vs. Leibniz, a clash of the titans; Voltaire vs. Needham, the generation controversy; Darwin's bulldog vs. Soapy Sam, evolution wars; Lord Kelvin vs. Geologists and Biologists, the age of the Earth; Cope vs. Marsh, the fossil feud; Wegener vs. everybody, continental drift; Johanson vs. the Leakeys, the missing link; and Derek Freeman vs. Margaret Mead, nature vs. nurture.

Hey Dr. Horwitz... tell us about Pi!

Instead of a profile of a person that one of us science faculty admire, we decided to do our profile column a little differently this month. In honor of the celebrations that will be occurring around the world on March 14th, we feature a profile of π! Now we're not sure who started officially recognizing this "holiday" or where the celebrations began. But Dr. Alan Horwitz of our mathematics department has decided to share with everyone a little bit of the story of π.

Let *C* be any circle. The circumference of *C* divided by the diameter of *C* is always the same, no matter what the radius or center of *C* are. That constant ratio is a real number called pi and denoted by the symbol π. To six decimal places π equals 3.141593, but this is only an estimate of π. It is perhaps a common misconception to think that π equals 22/7, but the exact decimal expansion of π never ends and has no repeating pattern. Such a real number is called irrational. Since 22/7 is a rational number, π cannot be equal to 22/7. Indeed, π cannot be equal to *m*/*n* for any integers *m* and *n*.

Archimedes (287-212 BC) came up with the estimate

$$\frac{223}{71} < \pi < \frac{22}{7}$$

Or $223/71 = 3.140845 < \pi < 3.142857$,

While Tsu Ch'ung Chi (430-501 AD) gave the estimate

$$\pi \approx 355/113 = 3.141593.$$

Many people since have developed algorithms to approximate π to more and more decimal places. With today's mathematics and the speed of today's computers, π has been calculated to 200 billion decimal places! (206,158,430,163 digits to be exact)

See the following websites for additional information about Pi:

http://www-groups.des.st-and.ac.uk/~history/HistTopics/Pi_through_the_ages.html

http://www.cecm.sfu.ca/personal/jborwein/Kanada_200b.html

DID YOU KNOW... that if a billion decimals of π were printed in ordinary type, they would stretch from New York City to the middle of Kansas???

AND LEST WE FORGET... another significant event needs to be recognized on this day. March 14, 1879, marks the birth of Albert Einstein in Ulm, Wür Hemberg, Germany. Einstein passed away in Princeton, NJ, on April 18, 1955.

Birthdays of Scientists!

- **03/03/1914**—Sir John Murray, Scottish naturalist (died 1914)
- **03/07/1837**—Henry Draper, American physician and amateur astronomer (died 1882)
- **03/14/1864**—Casey Jones, American railroad engineer (died 1900)
- **03/16/1874**—Francois-Emile b. Matthes, Dutch-born American geologist and topographer (died 1948)
- **03/20/1735**—Torbern Olof Bergman, Swedish chemist and naturalist (died 1784)
- **03/26/1893**—James Conant, American educator/scientist (died 1978)
- **03/29/1561**—Santorio Santorio, Italian physician, introduced use of precision instruments in medicine (died 1636)

March 2002

Sun	Mon	Tue	Wed	Thu	Fri	Sat
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3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Did you know... that on March 9, 1990, Dr. Antonia Novello was sworn in as surgeon general, becoming the first woman and the first Hispanic to hold the job!

Other noteworthy February events in science...

03-01-1872: Congress authorized creation of Yellowstone National Park.

03-07-1926: The first successful trans-Atlantic radio-telephone conversation took place, between New York City and London.

03-11-1888: The famous "Blizzard of '88" struck the northeastern United States, resulting in some 400 deaths.

03-13-1781: The planet Uranus was discovered by Sir William Herschel.

03-17-1950: Scientists at the University of California at Berkeley announced that they had created a new radioactive element, which they named "californium."

03-19-1918: Congress approved daylight-savings time.

03-24-1882: German scientist Robert Koch announced in Berlin that he had discovered the bacillus responsible for tuberculosis.

03-27-1964: Alaska was rocked by a powerful earthquake that killed 114 people.

03-31-1889: French engineer Alexandre Gustave Eiffel unfurled the French tricolor from atop the Eiffel Tower, officially marking its completion.

What happened in the year 1983 in science...

Computers: A mouse revolutionizes computing—While the computer "bug" is a creature that few of us want to see, the "mouse" was predicted to revolutionize the way we use computers. Apple's latest machine, Lisa, was the first to have a mouse as a standard feature. It had an attractive graphical interface, with icons (representing programs or files) that could be selected using a cursor. The mouse, which fit in your hand and lived on your desk, controls this cursor. Underneath the mouse was a ball that rolled as it was moved over the desk. Sensors registered the movements and moved the cursor on the screen.

Entertainment Technology: Compact disks arrive—The compact disk (CD) arrived as a new way to store recorded sound that was predicted to replace long-playing (LP) records. Compact disks have several advantages over other recording media. They are small, only 4-1/2 inches across, and yet can hold more than one hour of music. They are tough and much less likely to get damaged than LPs. Above all, the sound is stored on CDs as a digital code. This means that superb sound quality is possible. It also makes the disks very easy to use. If you want to play a track in the middle of the disk, you simply key in the track number on the player or remote control and the machine plays the track you want.

Earth Science: Old minerals discovered—Scientists at the Australian National University discovered the oldest known materials on Earth. They are tiny 4.2 billion-year-old crystals of the mineral zircon. They were found embedded in younger sedimentary rocks in western Australia. The zircon crystals were dated with radiometric dating, looking at the decay of uranium to lead. The original rocks the zircon grains came from either disappeared or have not been found.

Other noteworthy science news from 1983: (-) In Indianapolis, US Satellite Communications Inc. broadcasts the first TV programs by satellite; (-) The US space probe *Pioneer 10* becomes the first manmade vessel to leave our solar system; (-) The world's most powerful particle accelerator was built at Fermilab in Illinois.

Information for this column was obtained from Popular Science: Science Year by Year: Discoveries and Inventions from the Last Century that Shape our Lives (2001), New York: Scholastic, p. 186-187.

It all started at PSUDE with science...

The following is the second of a two-part interview with former DE alum Steve Urbanik.

Do you feel that PSUDE gave you the foundation you needed to pursue a career in science? My two years at PSUDE did provide a foundation for success at UP and in my career. Having two years of college behind me gave me a little more maturity when I arrived at UP. While there are expanded opportunities, there are also more distractions. Having invested two years, I was determined to not let the distractions get the best of me. For example, from intro sciences classes such as chemistry at PSUDE, I was well aware of how much time and effort some classes would require.

Any "words of wisdom" or helpful advice for current PSUDE science students? Grades are important. They open up more opportunities. I have reviewed some resumes and participated in some interviews in my current position and grades are something that is noticed. Good grades also make graduate school an option if someone is interested in further study. However, extracurricular activities are also important. In addition to good grades, we selected an intern for employment because of her list of other activities demonstrated enthusiasm and a wide range of interests in many different areas. On a more basic level, there is a lot to do in close proximity on a college campus. You may as well take advantage of it.

Get as much computer experience as possible. This would include courses, but just plain practical experience in areas like database management, modeling, graphics/publications, etc., in invaluable. Writing and public speaking skills (including a good resume and interview skills) are also very important.

Complete as many courses in your chosen field as possible. One does have to pay tuition for those classes, but too often people are in a rush to complete school or may be "burned out" as they near the end of their senior year. Years later you may find yourself wishing you had taken a few additional courses.

Participate in academic and social events in your field (e.g., academic clubs and professional societies). These are great ways to learn more about the field and also to meet people in it ("networking"). Many job opportunities are found through such contacts.

Finally, if you do not find a position right away, keep trying. I finished my degree in Earth Science, worked two years (but not in my career field) to earn money to pay the tuition for the Geoscience degree, worked for a year in photogrammetry (not geology, but a related field), before finally getting a position I was satisfied to have.

Do you know the answer to this science question?

Question: When was concrete first used in construction?

Answer: The Romans revolutionized building with the invention of concrete, which they first employed in the construction of the Coloseum. The foundation, laid on the site of an artificial lake in 70 A.D., is concrete. The upper structure is also concrete, faced with brick.

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Look on the web for more information! http://www.de.psu.edu/psu2de/

Featured Website Topic of the Month!

There are some outstanding websites available online that relate to any science topic you can possibly imagine! If you are looking for something that is scientifically "a little different," might we suggest…

The *Tyrannosaurus rex* named SUE

SUE is the largest, most complete, best preserved T. rex ever found. Approximately 67 million years old, she is 42 ft in length, weighed 7 tons while she was alive, and has 58 teeth that are 7-1/2 to 12" in length! She (well, we actually don't know if the skeleton is a male or female) was discovered in the Badlands of South Dakota in 1990. Now, here's where it gets interesting… to dig up dinosaurs, you need the permission of the landowner. But in SUE's case, it was unclear whose land it was because the bones were found on land that was part of a Sioux Indian reservation. But, the land belonged to a private rancher. BUT, the rancher was part Sioux, and his land was held in trust by the U.S. Government! We encourage you to read about the discovery, excavation and ensuing legal battles surrounding SUE!

The Field Museum, Chicago—SUE online
http://www.fmnh.org/sue/default.htm
Black Hills Institute of Geological Research, Inc.—The story of SUE
http://www.bhigr.com/pages/info/info_sue.htm
NOVA Online: Curse of T. rex (the story of SUE)
http://www.pbs.org/wgbh/nova/trex/index.html
Journal of Dinosaur Paleontology, collection of SUE articles
http://www.dinosauria.com/jdp/jdp.htm

Current Research at University Park

The December 6th issue of the journal *Nature* details a fascinating investigation of fossil teeth to elucidate the recent origin of human growth pattern.

Dr. Alan Walker, distinguished professor of anthropology and biology at Penn State University Park, has recently reported his research results with a colleague from University of London. They have determined that, according to an analysis of growth patterns in fossil teeth, the long period of development leading up to a modern human's adulthood arose relatively late in our evolutionary history.

Dr. Walker was a member of the team that discovered a juvenile skeleton in Kenya from one of the earliest species of the genus Homo, the *Homo erectus*. Walker actually pioneered the study of living primates as a basis for the analysis of fossils. He was one of the first to use the scanning electron microscope to study fossilized teeth. Why, you may ask?

"Dental development is a good measure of overall growth and development," comments Dr. Walker. "Teeth grow in an incremental manner like trees or shells, preserving a record of their growth with daily marks along the prisms that make up the enamel." By making thin sections of modern and fossil teeth, researchers are able to count the daily incremental markings within the enamel of humans, apes, and fossil hominid species in the human lineage in order to calculate and compare their rates of enamel formation.

Walker was surprised with the results of the 13 fossil tooth fragments he studied, going back 4 million years in age. None of the fossil fragments showed the slower pattern of modern human enamel growth. See, one thing that sets modern humans apart from the living great apes is our long period of growth and development—humans take 18-20 years to grow up, while other primate species take just 11-12 years. Walker found that Homo erectus, the first fossil human ancestor to show a suite of modern human-like characteristics, did now show evidence of a modern human-like growth period. "A Modern human-like growth period appears much more recently, in a Neanderthal fossil that lived ~120,000 years ago."

For additional information on this research, check out the following websites.

Alan Walker's website at PSU: http://www.bio.psu.edu/People/Faculty/detail.asp?pkey=201

PSU news release, "Fossil Teeth Reveal Recent Origin of Human Growth Pattern" http://www.science.psu.edu/alert/Walker12-2001.htm

Information about the field of Biological Anthropology: http://www.bioanth.org/

Biological Anthropology at Penn State: http://anthro.psu.edu/crculm/biological.html